R2D2

Reliability, Resilience and Defense technology for the grid

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Workshop on Pilot Sites

08.07.2025

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Reliability of energy assets through advanced inspection techniques (The Portuguese Pilot)

Motaz Ayiad / EDP

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Reliability, Resilience and
Defense technology for the grid

Current Pilot Information: Portugal

- EDP NEW – Pilot Coordinator
- E-Redes – Pilot Host
- Labelec – Affiliated Entity

Overall Pilot Needs and Objectives

- Enhance drone's inspection
- Reduction of outages.
- Reduction of maintenance costs.

- Pilot Location: Portugal (2 locations: MV Overhead line (Óbidos), Substation (Almeirim))

The Portuguese Pilot – ASSET #1 Infrastructure

- A 30 kV overhead MV line located in Óbidos, a city in the Leiria district.
- This line spans a length of about 69 km, around 45km of overhead line, with a significant portion passing through rural areas.
- The number of inhabitants supplied by this infrastructure are 2600 (15500 for the entire substation).

➢ **This asset is related to EMMA ARGOS Tool**

The Portuguese Pilot – ASSET #1 Infrastructure

Figure: The primary substation of the OH MV line in Óbidos town in the district Leiria.

Figure: a segment of the line passing through a forest.

The Portuguese Pilot – ASSET #2 Infrastructure

- The substation is located in Almeirim , a highly semi-urbanized city in Santarém district.
- This substation has two 60/30 kV Transformers (30 MVA).
- The substation is feeding a semi-urbanized city. It has overhead and underground lines.
- The number of inhabitants supplied by this infrastructure are 3000 residential customers and around 30 business clients.

- **This asset is related to EMMA SURVEILANCE and EMMA DYML Tool**

The Portuguese Pilot – ASSET #2 Infrastructure

Figure: Almeirim substation: components from inside the substation.

Figure: Almeirim substation: components from inside the substation.

UC1 – Overhead Power Line Inspection with EMMA ARGOS

Context

- Power grids are expanding and becoming more complex, increasing the burden on inspection and maintenance.
- Overhead lines are vulnerable to faults, vegetation interference, and environmental wear.
- Traditional inspection methods are slow, costly, and risky, especially in remote or hazardous areas.

Problem

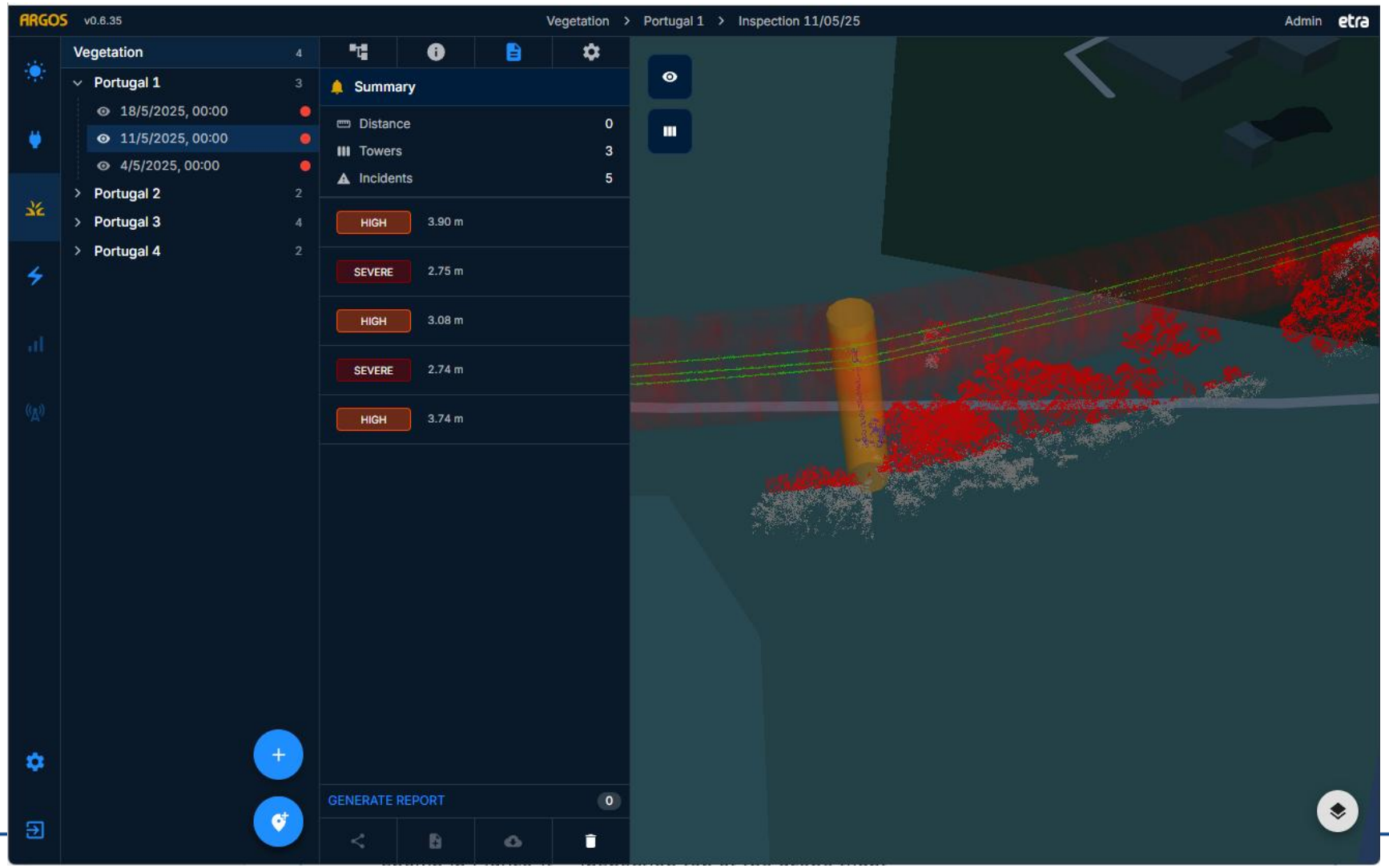
- Manual inspections are labor-intensive, error-prone, and limited in coverage (5–16 km/day).
- Data analysis is slow and reactive, leading to delayed maintenance and increased risk of outages.
- Lack of predictive tools results in unplanned corrective maintenance and reduced grid resilience.

UC1 – Overhead Power Line Inspection with EMMA ARGOS

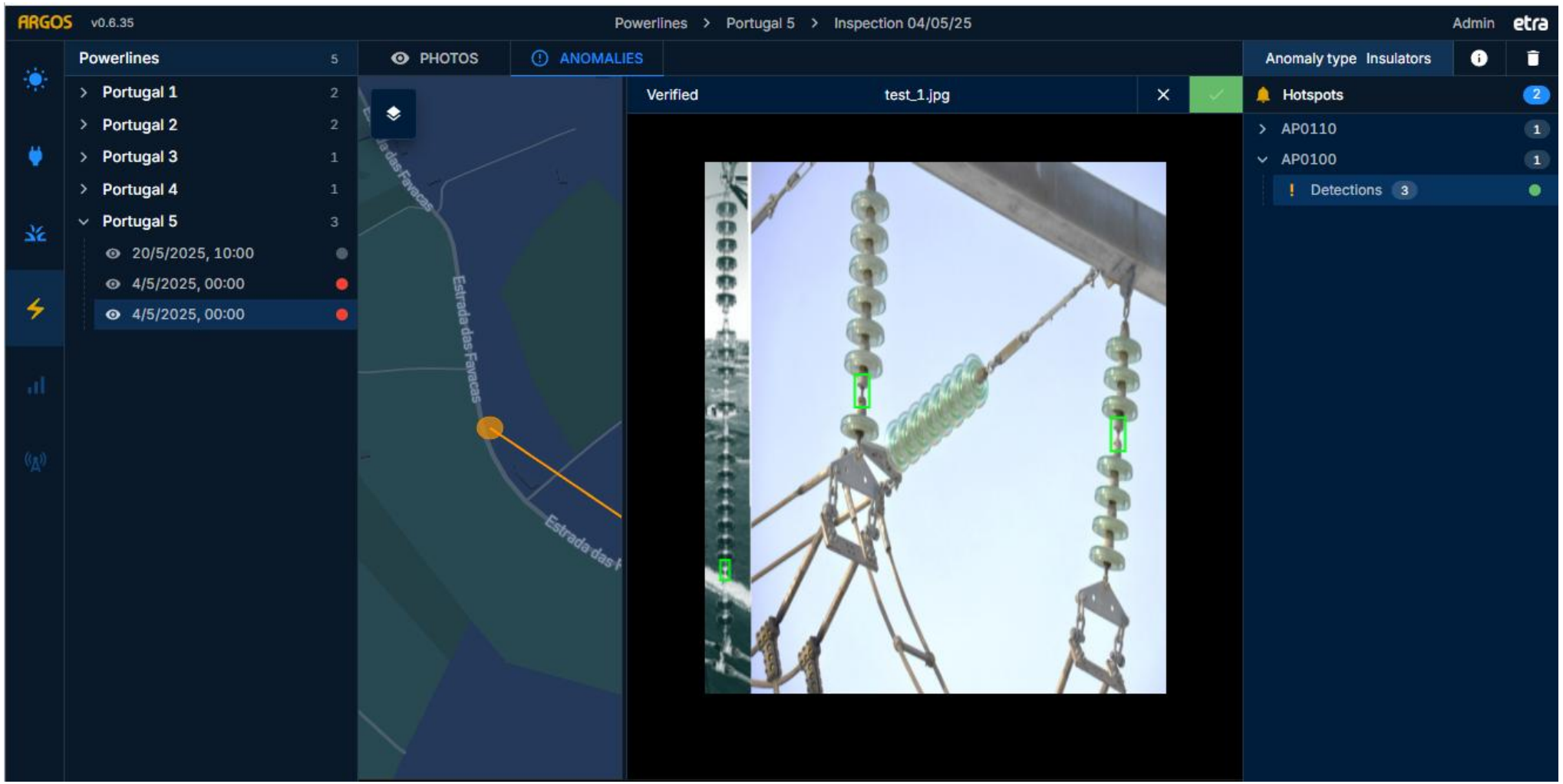
Solution

- EMMA ARGOS enables UAV-based autonomous inspections, capturing RGB, IR, and LiDAR data.
- AI-driven analysis identifies anomalies and prioritizes maintenance actions.
- Inspects 30–50 km/day at ¼ the cost of manual methods, with higher accuracy and safety.
- Predictive maintenance aligned with CER Directive Article 13 by enabling early detection and proactive intervention.

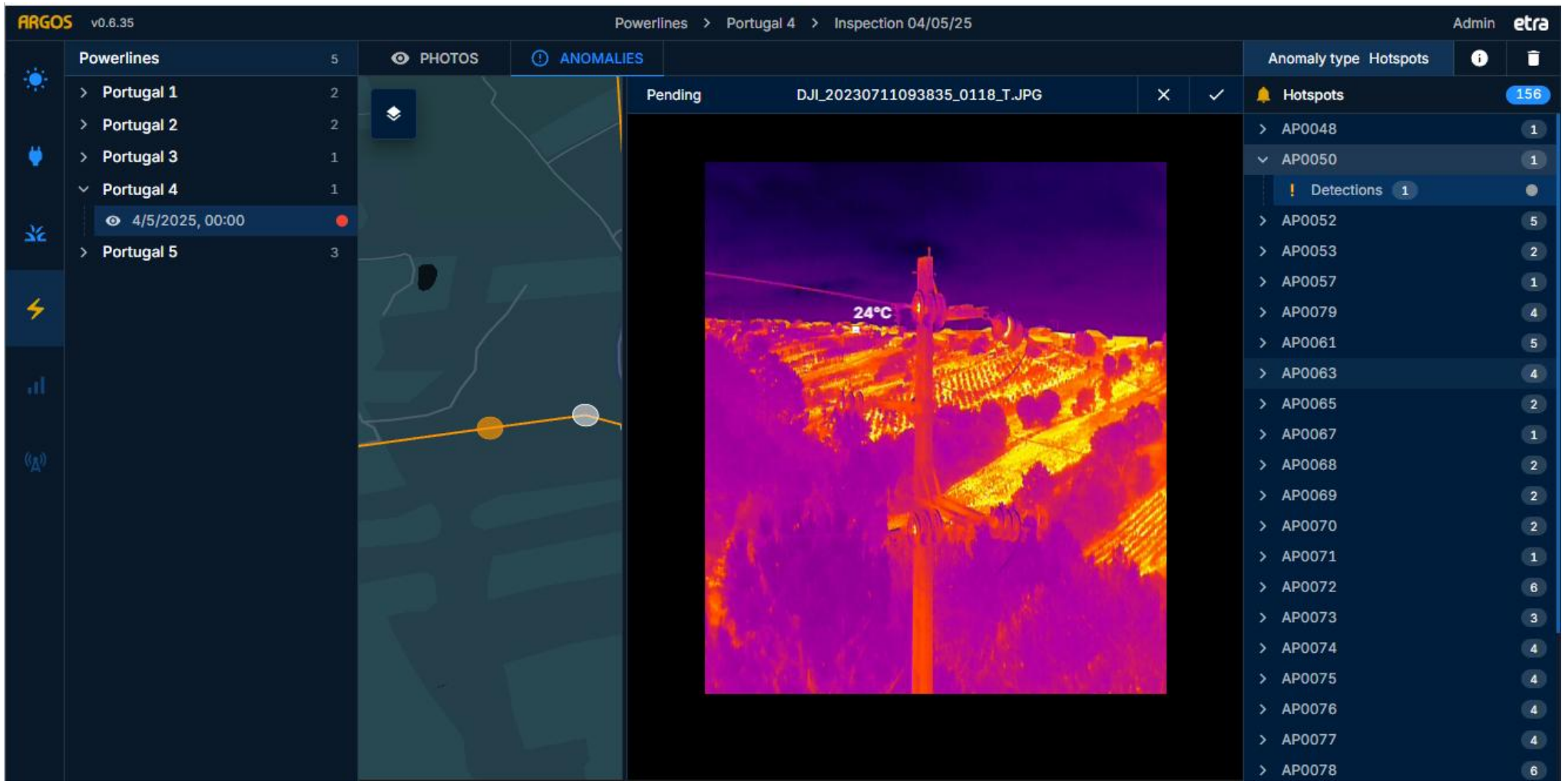
Vegetation encroachment



Structural anomalies



Thermal anomalies



UC6 – Substation Component Degradation Detection with EMMA SURVEILANCE and EMMA DYML

Context

- Substations are critical infrastructure with components designed for 50+ years of operation.
- Regular inspections are essential to ensure reliability, but current methods are manual and periodic.
- Digital substations and AI offer opportunities for smarter, real-time monitoring.

Problem

- Manual inspections are time-consuming, require skilled personnel, and often involve travel to remote sites.
- Lack of real-time monitoring increases the risk of unexpected failures and blackouts.
- Current practices do not support predictive maintenance or continuous surveillance.

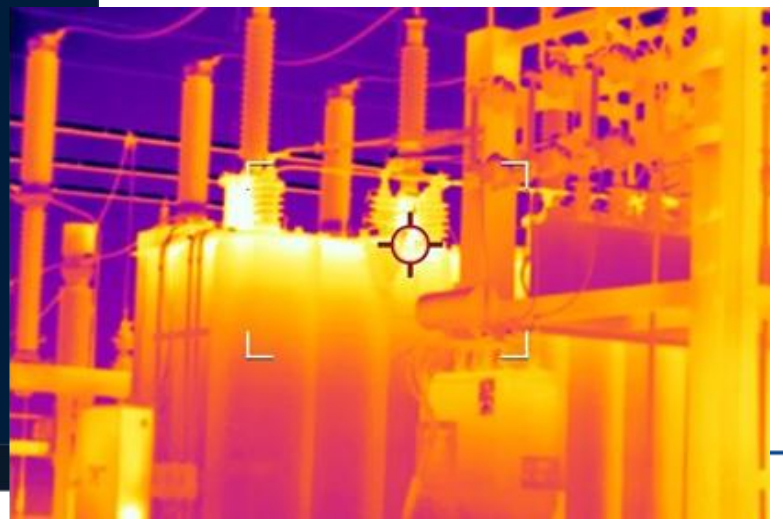
UC6 – Substation Component Degradation Detection with EMMA SURVEILANCE and EMMA DYML

Solution

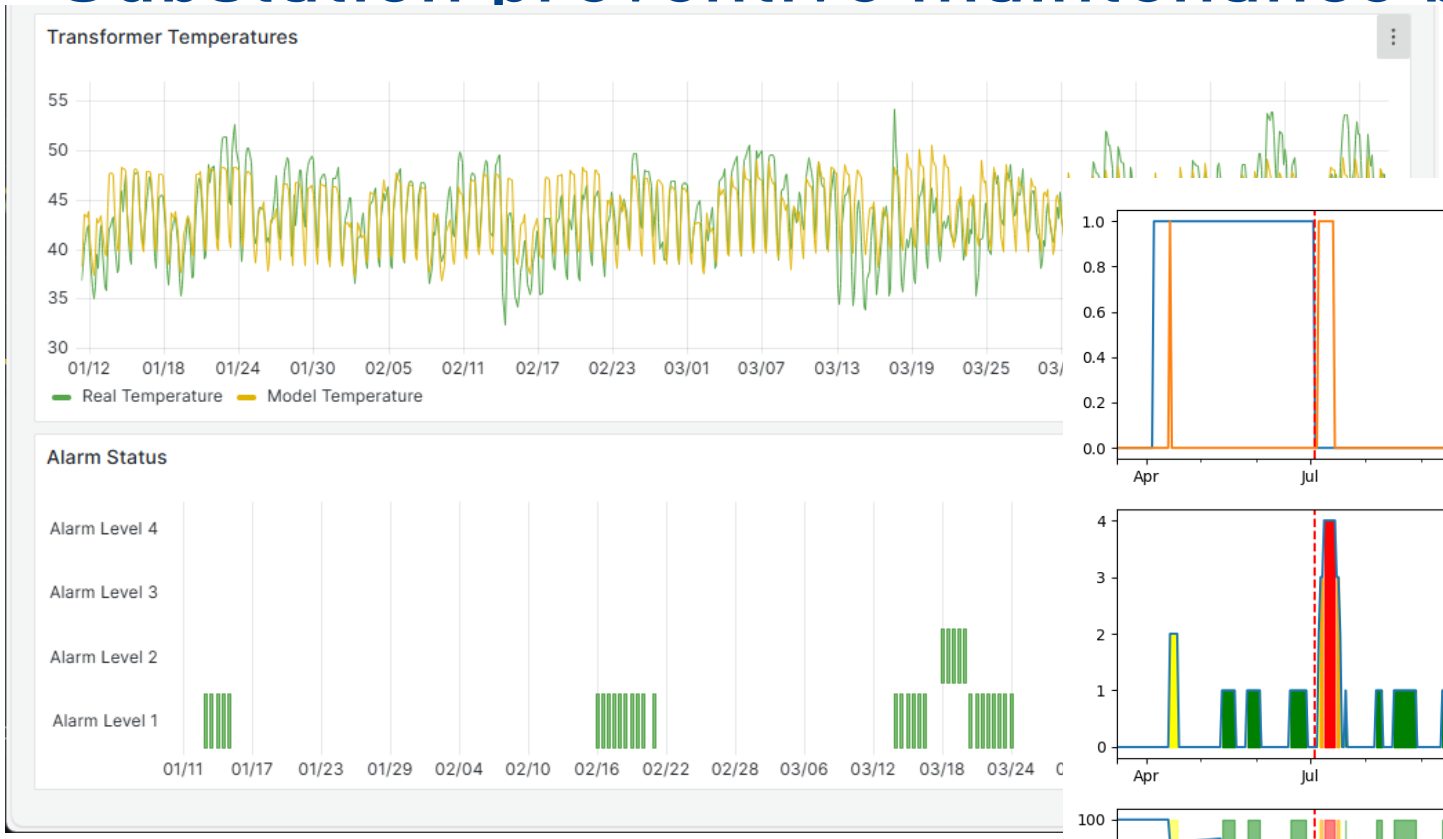
- EMMA DYML uses fixed or mobile cameras to capture thermal images.
- Enables predictive maintenance by AI-modelling the normal behaviour, comparing it with current evolution, flagging high-risk components and integrating results with scheduling tools.
- EMMA SURVEILLANCE AI models detect anomalies like wildfire, smoke, presence of animals, or unauthorized access, and warns operator accordingly.
- Supports CER Directive Article 13 by enhancing physical protection, monitoring, and early detection capabilities.

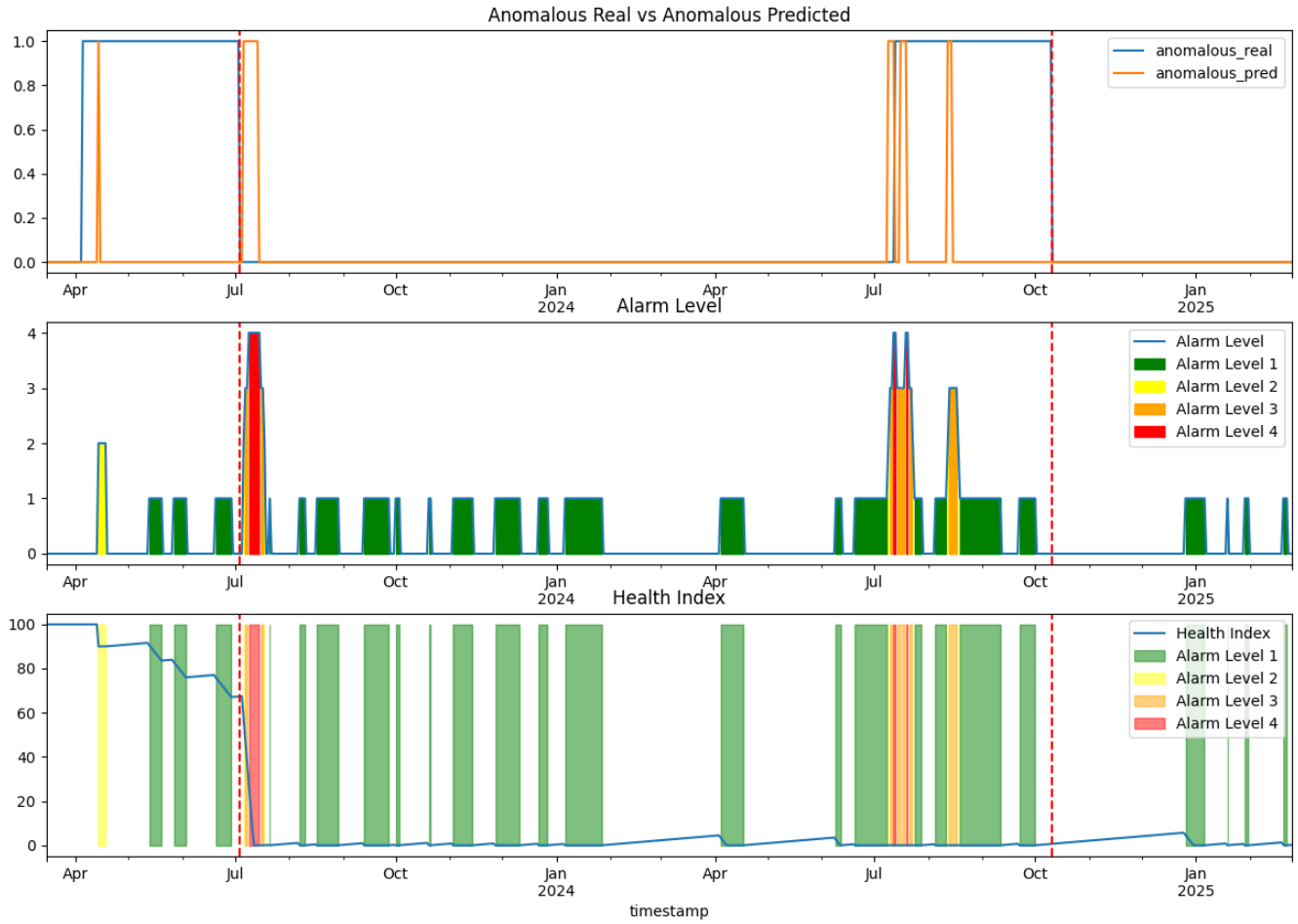
Thermal camera hotspot detection in substation

- Detects and alerts when substation components overheat
- Store thermal measurement for further thermal analysis preventive maintenance



Substation preventive maintenance based on temperature





- AI-based health index creation for allowing preventive maintenance on transformers (triggering alarms)

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